

Epidemiology of DOG BITES

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Human and Environmental Factors

A RECENT survey of animal bites in selected areas of the United States showed a "reported" animal bite rate of 362 per 100,000 human population per year (1). In the same study it was estimated that about 611,500 persons were bitten by animals in the United States

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during 1957. Domestic animal losses cost about \$1 million per year, and medical and public health expenses cost about \$5 million per year (2). Dogs bite people more often than do any other domestic animals in this country, and they are the most common source of human rabies (3). Although dog bites occur frequently, produce human injury, pain, and anxiety, and are costly, as yet there has been no detailed epidemiological study of this problem. Epidemiology has demonstrated its value in acquiring the necessary facts to control infectious diseases and recently has been used successfully to study noninfectious and chronic diseases (4,5) as well as other kinds of animal bites (6). In this study we have tried to elicit the various human, dog, and environmental

factors associated with dog bites, and to determine if these factors indicate ways to prevent and control dog bites.

Materials and Methods

All dog bites reported during July and August 1958, in Pittsburgh, Pa., were studied in detail. This period was selected because dog bites are most prevalent during these summer months. Special dog bite report forms were mailed to the hospitals within the city limits and to physicians (general practitioners, internists, surgeons, and pediatricians) who might be expected to treat dog bite cases in their offices. Practicing veterinarians, personnel working in animal hospitals, members of the Animal Rescue League, and the police were also asked to report dog bites.

The report forms contained detailed questions about each dog bite accident. The information on the victim included name, address, age, sex, race, occupation, if he had been bitten during the past 5 years, and if he knew that the dog had bitten other people. Other data included the kind of animal inflicting the bite (hospitals were asked to report all animal bites), the hour (a.m. or p.m.), date, geographic place, anatomic location, and circumstances under which the bite took place, length and depth of the wound, number of sutures that would have been required if the wound had resulted from ordinary trauma, a checklist of items used in treatment, and the name and address of the animal's owner.

When the dog inflicting the bite was traced, its owner was asked to supply additional information to identify the factors associating the animal with the dog bite accident. These factors are described on pages 898-903.

Incidence

During the 2-month period, 947 dog bites were reported in Pittsburgh, 507 during July and 440 during August 1958, a bimonthly incidence of 14 dog bites per 10,000 human population. The annual incidence of dog bites in Pittsburgh is of about the same magnitude as that reported for other cities of comparable size in this country (1). It was felt that most of the treated dog bites in the city were reported; in 1957 only 230 bites were reported to have

occurred during July and 204 during August. Apparently the reporting system was more effective during July and August 1958 than during the same period in 1957. This improvement can be attributed to private physicians reporting dog bite victims whom they treated in their offices. Of course, some dog bite victims do not seek medical treatment. This seems particularly true if a dog bites his owner.

Characteristics of Victims

Sex. The bimonthly incidence of dog bites per 10,000 population was 19.46 for males and 8.84 for females. Therefore, males were the victims of dog bite accidents more than twice as frequently as females. This finding is consistent with the observation that males are more frequently involved in most types of accidents than females (7). This striking sex difference in the incidence of dog bites becomes apparent before the victims reach 5 years of age. Perhaps the high incidence of dog bites among males results from their more aggressive behavior and the fact that males are more likely to have dogs as pets. Generally, females prefer cats or other small animals as pets. Males had higher rates of dog bites in practically every age group (table 1).

Age. The victim's age was an important variable in dog bites. Eighteen percent of all victims were less than 5 years of age, 31 percent of the victims were 5 to 9 years old, and 27 percent were 10 to 19 years of age. Thus, 76 percent of all the victims were less than 20 years of age. For the most part this group consisted of preschool and school children. The rate of dog bites per 10,000 population provides a more meaningful measure of high-risk groups by age. School boys and girls aged 5 to 9 years have the highest bite rate (table 1). The second highest bite rate for males was found in the age group 10 to 19 years, whereas the second highest rate among females was in the less-than-5-year-old group. Children and youths less than 20 years of age have the highest rate because they are intimately associated with dogs as pets, they are often abusive to pets, and, in many instances, they do not know how to care for pets properly. In addition, persons less than 20 years of age are more likely to be engaged in

Table 1. Incidence of dog bites in Pittsburgh, Pa., July and August 1958

Age group (years)	Males			Females		
	Population at risk ¹	Number bites reported	Rate per 10,000	Population at risk ¹	Number bites reported	Rate per 10,000
0-4.....	31,390	101	32.17	30,623	73	23.84
5-9.....	25,123	185	73.63	24,566	104	42.33
10-19.....	41,743	184	44.07	44,714	68	15.21
20-29.....	54,655	38	6.95	60,358	10	1.66
30-39.....	50,787	40	7.88	56,375	9	1.60
40-49.....	44,069	44	9.98	47,358	19	4.01
50-59.....	39,312	22	5.60	39,184	10	2.55
60-69.....	26,999	8	2.96	27,676	10	3.61
70 and over.....	14,329	17	11.86	17,545	5	2.85
Total.....	328,407	639	19.46	348,399	308	8.84

¹ Based on the 1950 U.S. census of the population of Pittsburgh, Pa.

activities which excite dogs, such as playing ball, running, riding bicycles, and delivering newspapers.

Race. There were 540 white males and 99 nonwhite males and 263 white females and 45 nonwhite females bitten by dogs. Although there were more bites among whites than nonwhites, the incidence of bites per 10,000 population at risk was higher for the nonwhites. The nonwhite population of Pittsburgh is not large and is composed primarily of Negroes. The rates of bites per 10,000 population was 18.75 for white males compared with 24.48 for nonwhite males, and 8.60 for white females compared with 10.58 for nonwhite females. There were no significant differences between the bite rates of the whites and the nonwhites, for both sexes, up to the age of 20 years.

From 20 through 49 years of age the nonwhites had a high rate of dog bites. This finding was associated with the occupations of the victims. Most of the nonwhite victims in this age range were employed in occupations which brought them to the dog owner's home in their jobs as delivery men, mailmen, milkmen, laborers, and garbage collectors. There was no evidence to suggest that nonwhites were more likely to report dog bites than whites, nor that dogs were more partial to biting nonwhite than white persons. The higher rate of dog bites among Negroes in Pittsburgh is in agreement with data obtained from a survey of dog bites in Arlington, Va. (8).

Occupation. Definite groups of individuals run a high risk of being bitten by dogs. School children and preschool children were the most frequent victims, especially if they either owned a dog or lived within three houses of a dog owner's home (table 2). Persons coming to the dog owner's home in the line of work also were frequently bitten. If newspaper boys and mailmen were included in this group, then 13 percent of all the victims were in this occupational category. During July and August 1958, 33 newspaper boys and 26

Table 2. Occupations of dog bite victims, Pittsburgh, Pa., July and August 1958

Occupation	Persons bitten		Number previous dog bites last 5 years
	Number	Per-cent	
School child.....	414	44	27
Preschool child.....	239	25	21
Persons coming to house in line of work ¹	56	6	2
Housewife.....	50	5	2
Newspaper boy.....	33	4	2
Mailman.....	26	3	3
Police or fireman.....	7	<1	0
Veterinarian.....	6	<1	0
All others.....	116	12	5
Total.....	947	100	62

¹ Delivery man, 12; milkman, 12; gardener, plumber, painter, meter reader, 12; salesman, insurance collector, 11; utility man, laborer, 6; and garbage collector, 3.

mailmen were bitten by dogs in Pittsburgh. Projection of these findings to a national level indicates that probably tens of thousands of newspaper boys and postmen are bitten by dogs in this country annually. Veterinarians and their assistants also would appear to be frequent victims of dog bites. For example, of the six veterinarians bitten during this 2-month period, five, or 83 percent, stated that they had suffered previous dog bites during the past 5 years.

The percentages of individuals in the various occupational groups who experienced previous dog bites in the past 5 years were mailmen, 11; preschool children, 9; school children, 6; newspaper boys, 6; housewives, 4; and persons coming to the house in the line of work, 4. These findings further demonstrate the frequency of dog bites in these occupational groups. Measures to prevent and control dog bites should be directed toward these high-risk occupational groups.

Anatomic part bitten. As one might suppose, most dog bites (76 percent) were inflicted on the extremities, 39 percent on the legs and 37 percent on the arms. This anatomic distribution of bites is consistent with the height of dogs in relation to man, with the fact that people use their arms and legs to ward off attacking dogs, and with the observation that the extremities provide a better biting surface for dogs than the trunk.

It is shocking that 151, or 16 percent, of the dog bites occurred on the victim's head, face, and neck. With four exceptions, all of these potentially disfiguring bites about the head, face, and neck occurred among children less than 12 years of age. In a community survey of dog bites in Arlington, Va., 17.8 percent of the bites were located on the head and neck of the patients (8). One investigator reported that 25 percent of all dog bites treated in a general hospital were on the head and neck of the victims (9). Only 33, or 4 percent, of the 947 dog bites were on the buttocks and lower back.

Severity of wounds. Prior to this study, little was known about the severity of the wounds resulting from dog bites. The concept of a biological gradient was used for classifying the severity of dog bites. At the two extremes of

the gradient are dog bites which produce no detectable injury and those which result directly or indirectly in the death of the individual. Wounds were classified according to severity as (a) none—dog bites producing no detectable injury; (b) minor—dog bites producing abrasions, lacerations, contusions, and puncture wounds which would not have required sutures if the wound had been produced by ordinary trauma (not an animal bite); (c) moderate—wounds which would have required from 1 to 10 sutures if they had resulted from trauma; and (d) severe—wounds which would have required more than 10 sutures if they had resulted from trauma.

Of the 947 reported dog bites, 20, or 2 percent, produced no detectable injury; 831, or 88 percent, resulted in minor injuries; 86, or 9 percent, were moderate injuries; and only 10, or 1 percent, were severe injuries (table 3). There were no fatal injuries. Dog bites which result in no detectable injury probably occur in greater numbers than indicated in this study because these patients do not often seek medical treatment. Also, it seems likely that many persons with minor injuries resulting from dog bites fail to seek medical treatment. Therefore,

Table 3. Anatomic location and severity of dog bite wounds of victims, Pittsburgh, Pa., July and August 1958

Location of wound	Severity of wounds ¹				Total	
	None	Minor	Moderate	Severe	Number	Percent
Upper extremities-----	7	304	37	3	351	37
Lower extremities-----	9	345	15	1	370	39
Head, face, and neck-----	1	110	34	6	151	16
Trunk, excluding back-----	0	42	0	0	42	4
Back and buttocks-----	3	30	0	0	33	4
Total-----	20	831	86	10	947	100

¹ None—dog bite, no detectable wound; minor—abrasions, lacerations, contusions, and puncture wounds which would not have required sutures if they had resulted from trauma (not an animal bite); moderate—wounds which would have required 1–10 sutures if they had resulted from trauma; severe—wounds which would have required more than 10 sutures if they had resulted from trauma.

probably somewhat less than 10 percent of all dog bites produce moderately severe and severe injuries.

Few human fatalities result from dog bites. During 1955 there were only 10 human deaths in the United States from dog bites (1). It is of interest that the percentages of moderately severe and severe injuries according to the anatomic sites were head, face, and neck, 26 percent; upper extremities, 11 percent; and lower extremities, 4 percent. This phenomenon seems indirectly related to the amount of protective clothing worn over these parts of the body.

The head, face, and neck are usually uncovered, while shoes, socks, skirts, and trousers afford some protection to the lower extremities. In this study, only 2 of the moderately severe and severe dog bite wounds on the extremities required subsequent plastic surgery, while 13 of those on the head, face, and neck did. Other studies are in agreement that a high proportion of dog bite wounds requiring surgical and plastic surgical procedures are on the head, face, and neck (9, 10).

Mechanism of bite accidents. One of the most interesting aspects of dog bites is the manner in which they occurred. A recent study of mammalian bites among young children indicated that often the child—and not the animal—provoked the bite (11). To elicit the causes, the victim's account of the circumstances of the bite was compared with the dog owner's account of how the bite happened. It was felt that the owner's views might present the dog's side of the story. The dog owners were eager to cooperate in this study, expressed sympathetic concern for the victims, and, with two exceptions, displayed no hostility. About one-third (32 percent) of the owners stated that they witnessed the dog bite accident, and an additional 13 percent of the dog bite accidents were seen by another member of the family or by a neighbor. Therefore, about one-half of the dog bite accidents were witnessed by a person other than the victim.

The mechanisms of bite accidents fall into four major categories: (a) bites unprovoked by humans; (b) bites incurred while petting or playing with dogs; (c) bites precipitated by human activities; and (d) all others (table 4). In only 9 percent of the bites did the dog own-

Table 4. Victims' accounts of circumstances of dog bite accidents, Pittsburgh, Pa., July and August 1958

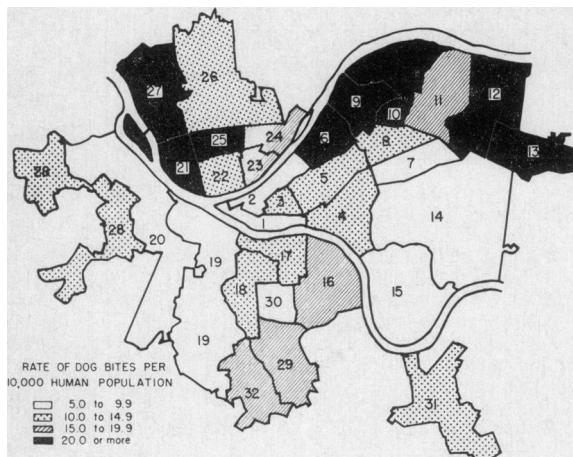
Victim's account of dog bite	Dog bites	
	Number	Percent
Bites unprovoked by man.....	335	35
Bitten while visiting home in line of work.....	56	6
Bitten while delivering newspaper.....	33	3
Bitten while delivering mail.....	26	3
All other unprovoked attacks.....	220	23
Bitten while petting or playing with dogs.....	347	37
Petting or playing with dog.....	229	24
Riding bicycle, motor scooter, vehicle.....	44	5
Child running while playing.....	33	4
Playing ball with dog.....	23	2
Playing with chained dog.....	18	2
Bites precipitated by human activities.....	237	25
Feeding dog.....	67	7
Abusing or teasing dog.....	59	6
Separating fighting dogs and cats.....	28	3
Accidentally stepping or falling on dog.....	19	2
Picking up or holding dog.....	16	2
Helping injured animal.....	16	2
Playing roughly with dog's owner.....	11	1
Picking up pup.....	11	1
Abruptly arousing sleeping dog.....	10	1
All others.....	28	3
Total.....	947	100

ers disagree with the victim about how the bite happened. Approximately 4 percent of bites unprovoked by man and 5 percent of the bites incurred while petting or playing with dogs were attributed by the owners to abusing and teasing the dog or to trespassing. Taking these differences into account, it seems reasonable to state that about one-third of the bite accidents resulted from dogs biting maliciously without human provocation; one-third, while the victims were petting or playing with dogs; and one-third, when human activities provoked the dogs to bite.

Environmental Factors

There is a definite biological pattern for dog bites just as there is a comparable pattern for

Geographic distribution of dog bites by wards in Pittsburgh, Pa., July and August 1958



other types of animal bites (6, 12). Some of the environmental conditions investigated in this study were the geographic distribution of bites by city wards, the relation between bites and proximity to the dog owner's home or the victim's home, the seasonal variation of bites, and the frequency of bites according to days of the week and hours of the day.

Geographic location. To test the hypothesis that dog bites occur more frequently in residential areas than in business and industrial areas of the city, the incidence of dog bites by city wards was calculated by tracing the address where the bite was reported to have happened.

Estimates of the 1957 population rather than the 1950 census, which does not reflect recent population movement within the city, were used to calculate the incidence of dog bites per 10,000 human population for the 32 wards of Pittsburgh during the study period (see chart).

Wards 1 and 2 are downtown business areas of Pittsburgh which had less than 10 bites per 10,000 population. The wards with the highest rates of bites (6, 9, 10, 12, 13, 21, 25, and 27) are primarily residential; industrial areas (17, 19, and 20) had relatively low rates. Some of the differences in rates among wards may be due to differences in dog populations. Poor reporting in some wards was not thought to be a major bias influencing the incidence of bites.

These findings reflect the fact that dog bite accidents are most prevalent in areas where homes are most abundant, and children, the

most frequent victims, and dogs are more common.

The report forms also indicated that most bite accidents happened in the vicinity of the dog owner's residence rather than the victim's (table 5). Vicinity included inside the home, the yard, and the street in front and back of the home; neighborhood was the area within 2 blocks' radius of the home. In the study, 65 percent of the accidents occurred in the vicinity of the dog owner's home, 18 percent in the neighborhood near the dog owner's home, and 9 percent in the vicinity of the victim's home. Most of the dogs responsible for bites which occurred away from the neighborhood of the dog owner's home and the victim's home were difficult to trace. Presumably, a large proportion of these animals were stray dogs.

Seasonal variation. In a previous publication (1) we demonstrated a seasonal distribution for dog bite accidents in Pittsburgh. The incidence of bites was lowest during the winter months, increased during March and April, and reached a peak during the summer months. A similar seasonal distribution of dog bites was reported for Arlington, Va. (8), and for Ann Arbor, Mich. (9). These observations are sup-

Table 5. Places where dog bite accidents occurred, Pittsburgh, Pa., July and August 1958

Place of accident	Dog bites	
	Number	Percent
Vicinity of dog owner's home.....	612	65
In dog owner's yard.....	358	38
Street in front or behind owner's yard.....	120	13
Inside owner's house.....	87	9
On porch of owner's house.....	47	5
In neighborhood ¹ near dog owner's home.....	166	18
Vicinity of victim's home.....	83	9
In victim's yard.....	53	6
Street in front of or behind victim's yard.....	19	2
Inside victim's house.....	11	1
On sidewalk or street not near owner's or victim's home or neighborhood ¹	37	4
Park or playground.....	20	2
Animal hospital.....	6	<1
All others.....	23	2
Total.....	947	100

¹ Area within 2 blocks' radius of home.

Table 6. Day of week and time of day dog bite accidents occurred, Pittsburgh, Pa., July and August 1958

Time of day	Mon-day	Tues-day	Wednes-day	Thurs-day	Friday	Satur-day	Sunday	Total	
								Number	Percent
6-11:59 a.m.-----	12	29	36	14	21	12	17	141	15
12-5:59 p.m.-----	51	44	41	56	60	50	59	361	38
6-11:59 p.m.-----	43	65	48	48	60	66	58	388	41
12-5:59 a.m.-----	0	5	6	0	8	2	3	24	3
Unknown-----	6	4	7	4	0	8	4	33	3
Total-----	112	147	138	122	149	138	141	947	100

ported by clinical impressions of epidemics of dog bites during the summer months and by popular notions of dog days. There is reason to believe that this seasonal variation of dog bites is nationwide; however, it is probably not as distinct in the southern parts of the country. The high incidence of bites during the summer months more likely resulted from more children being "exposed" to dogs at this time. Also, in colder climates dogs are allowed more freedom during summer months.

During the winter (school) months most dog bites occurred on Saturday and Sunday (1). However, during the summer months there was little variation in the frequency of bites by days of the week (table 6). Of 947 reported bites, 141, or 15 percent, happened from 6 to 11:59 a.m.; 361, or 38 percent, from 12 to 5:59 p.m.; 388, or 41 percent, from 6 to 11:59 p.m.; and 24, or 3 percent, from 12 to 5:59 a.m. The time was unknown for 33, or 3 percent, of the bites. Of course, not many dog bites would be expected from 12 to 5:59 a.m., but it is difficult to explain why only 15 percent of the bites occurred from 6 to 11:59 a.m. Most dog bites (79 percent) happened between noon and midnight.

Discussion

This study of the epidemiology of dog bites would seem to indicate that human factors are more important than environmental factors in the genesis of dog bites. Most environmental factors associated with dog bites reflect man's activity at a particular place or time rather than specific effects of environment per se.

However, the geographic distribution of bites by city wards points out areas where intensive control measures should be carried out.

On the basis of human factors which were unveiled in this study, certain recommendations for the prevention of dog bites can be made:

- Do not give a dog to children under the age of 6 years. This might help eliminate about 18 percent of the bites.

- Teach children how to care for their pets and not to abuse or tease dogs.

- Discourage playing ball with a dog, riding bicycles and other vehicles in the vicinity of excited dogs, and running while playing with a dog, if it excites him. These measures might prevent about 10 percent of all dog bites.

- Do not pet, startle, or take food away from a dog while feeding him and do not intercede in dog fights. These suggestions might eliminate another 10 percent of the bites.

- Exercise caution while assisting injured and sick animals, avoid abruptly arousing sleeping dogs, and be careful in picking up pups so as not to offend the mother dog. These measures might prevent another 3 percent of all bites.

- Avoid holding your face next to a dog's to prevent disfiguring facial wounds.

Admittedly, these preventive measures are confining for dog owners, but they are suggested on the basis of scientific facts, and if they were followed, about 40 to 50 percent of all dog bites might be prevented.

Summary

An epidemiological study was made of 947 dog bite accidents which occurred in Pitts-

burgh, Pa., during July and August 1958. The incidence of bites per 10,000 human population was 19.46 for males and 8.84 for females; 76 percent of the victims were less than 20 years of age. The rate of bites was higher for non-whites than for whites.

High-risk groups identified were: school children, preschool children, persons coming to the dog owner's house in the line of work, newspaper boys, mailmen, and veterinarians.

Seventy-six percent of the bites were inflicted on the extremities, 16 percent on the head, face, and neck, and 8 percent on the trunk. Only about 10 percent of the bites were moderately severe or severe. There were no fatal dog bites. A high percentage of facial wounds required subsequent plastic surgery.

About one-third of the bite accidents resulted from dogs biting maliciously without human provocation, one-third happened while the victims were petting or playing with dogs, and one-third were attributed to human activities which caused the dogs to bite.

The following environmental factors were identified: the incidence of bites was higher in residential than in business or industrial areas of the city; 65 percent of the bites happened near the dog owner's home, 18 percent in the neighborhood near the owner's home, 9 percent near the victim's home, and the remaining 8 percent occurred elsewhere in the city; most dog bites happened during the spring and summer months; and 79 percent of the bite accidents occurred between noon and midnight.

Characteristics of Biting Dogs

PRACTICALLY NOTHING is known about the characteristics of dogs which bite man. The question of how the dogs involved in dog bite accidents differ from other dogs is as important to the veterinary epidemiologist studying dog bites as determining the classification, type, and strain of a bacterial agent is to a microbiologist.

In an epidemiological study of 947 dog bite accidents which occurred during July and August 1958 in Pittsburgh, Pa., we tried to determine what breeds of dogs are most likely to bite people, to elicit other characteristics, such as age and sex, of the dogs associated with accidents, and to find the pertinent animal factors which are necessary for planning an adequate dog bite and rabies control program.

In this study the name and address of the owner of the dog were obtained from the dog bite report forms sent in by hospitals and physicians treating bites. When this information was not available from the report form, the Allegheny County Health Department and the Pittsburgh Police Department traced the dog owners. They were requested to complete a questionnaire supplying the following information: the name and address of the owner;

the age, sex, and breed of the dog; number of times the dog had bitten other people within the past year; vaccination against rabies and date; possession of a 1958 dog license and the number of the license; involvement in frequent dog fights; the circumstances of the bite accident as the owner understood it; and whether the owner witnessed the bite accident.

One serious limitation to all dog population estimates is the unknown number of stray dogs. This statistical problem was circumvented by limiting the study to licensed dogs.

According to the records of the Pittsburgh Dog Licensing Bureau, 19,334 dog licenses were issued as of September 1, 1958, 15,579 for male dogs and 3,755 for female dogs. The rates of bites inflicted by licensed dogs were computed using 19,334 as the population base. Information about the age, sex, and breed was obtained by studying a 2 percent random sample of the total licensed dog population.

Incidence

Of the 947 dogs inflicting bites, 767, or 81 percent, were traced to owners, and 180, or 19 percent, could not be traced. Presumably, a